P27376.A12

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Hiroaki Matsumoto | Conf. No.: 1887

Serial No.:10/756,392 | Group Art Unit: No. 3683

Filed: January 14, 2004 | Examiner: Thomas Williams

For: BRAKE CONTROL APPARATUS

SUPPLEMENTAL TO THE SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT FILED ON MARCH 31, 2006

Commissioner of Patents
U.S. Patent and Trademark Office
Customer Window, Mail Stop Amendment
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Sir:

Consistent with the Supplemental Information Disclosure Statement filed on March 31, 2006, the following are English language translations of the documents listed in the Supplemental Information Disclosure Statement filed on March 31, 2006:

(1) English language translation of publication entitled Study on Vehicle ABS (3 sheets) which published on June 30, 1993. A copy of this publication is also enclosed with certain headings being translated into English; and

(2) English language translation of publication entitled Performance of Vehicular Movement and Mechanism of Chassis (3 sheets) which published on September 10, 1994. A copy of this publication is also enclosed with certain headings being translated into English.

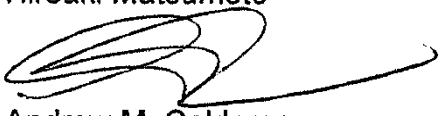
P27376.A12

Copies of documents (1) and (2) are enclosed. A completed copy of the PTO-1449 Form listing all of the above-listed documents is also enclosed. Accordingly, the Examiner is requested to consider documents (1) and (2) and to indicate such consideration by returning a signed initialed copy of the PTO-1449 form with the next official communication.

Applicant submits that no additional fee is required as Applicant has submitted the required fee when Applicant filed the Supplemental Information Disclosure Statement filed on March 31, 2006.

The Commissioner is hereby authorized to charge any additional fees concerning the application to Deposit Account No. 19-0089.

Respectfully submitted,
Hiroaki Matsumoto



Andrew M. Calderon
Registration No. 38,093

April 13, 2006
Greenblum & Bernstein, P.L.C.
1950 Roland Clarke Place
Reston, Virginia 20191
Telephone: 703-716-1191
Facsimile: 703-716-1180

PTO/SB/08a (08-03)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	10756392
Filing Date	2004-01-14
First Named Inventor	Hiroaki MATSUMOTO
Art Unit	3683
Examiner Name	Thomas Williams
Attorney Docket Number	P27376

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Examiner Name	Thomas Williams
	Attorney Docket Number	P27376

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement.

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement.

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	
Name/Print	/Andrew M. Calderon/	Registration Number	38,093

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

("Study on Vehicle ABS")

.....As Fig. 2-6 shows, the vehicle undergoes a movement which is a combination of the above described two phenomena. In other words, regardless of driver's steering, the vehicle slides along a tangential direction of the curb while spinning irregularly.

As described above, although it is possible to effectively stop a vehicle by braking with a suitable strength, over-braking can lock up the wheels, which is the largest cause for various dangerous vehicle movements. Therefore, a driver must always be careful to avoid locking up the wheels by braking according to road and driving conditions, such as a freezing road, a snowy road, a graveled road, a rough road, a wet road, a dry road, a straight road, a curb, the speed of the vehicle, steering, and the like.

2.1.2. Shifting of load

The weight of a vehicle is supported by the wheels. Therefore, as shown in Fig. 2-7, a vertical force, called a tire load, acts on the contact area of a tire and the road surface. Because of a braking force due to braking and an inertia force (mass × acceleration/deacceleration), which acts on the center of gravity of the vehicle due to a centrifugal force when cornering, the tire load changes as follows.

(1) Change due to braking

A braking force generated by braking is expressed as a product of a tireload and a friction coefficient. A vehicle reduces speed at a rate proportional to a sum of braking forces. An inertia force, which is the same in magnitude as the sum of the braking forces, but in an opposite direction, i.e., in the driving direction, acts on the center of gravity of the vehicle. Therefore, a torque is generated, which tends to plunge the vehicle forward, resulting in an increase of ΔW_b in tire load for front wheels and a decrease of ΔW_b in tire load for rear wheels.

Hisao NAGATSUMA
Born in 1946.
Joined Japan ABS Co., Ltd. in 1988.
Currently, conducting ABS/ASR software development and design, as a department chief for the Software Design Department in the Electronics Design Division.

Hideo KIGOSHI
Born in 1947.
Joined Nippon Air Brake Co., Ltd. (now Nabco) in 1970. Conducted development, design, and system development of vehicle ABS actuators.
Currently, conducting commercial vehicle ABS/ASR development and design, as a general manager for the Second Development Department in the Automobile Technology Division.

Yasuo SAMATSU
Born in 1952.
Joined Japan ABS Co., Ltd. in 1985.
Currently, conducting ABS/ASR actuator development and design, as a department chief for the First Equipment Design Department in the Technology Division.

Yoshifumi AKAKABE
Born in 1954.
Joined Japan ABS Co., Ltd. in 1985.
Currently, conducting patent and technology management, as a department chief for the Management Department in the Technology Division.

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June 30, 1993, first print.
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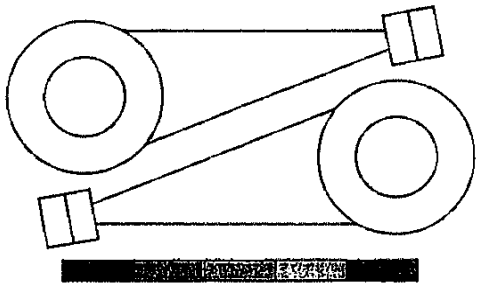

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自動車用ABSの研究

日本エーピーエス株式会社 編

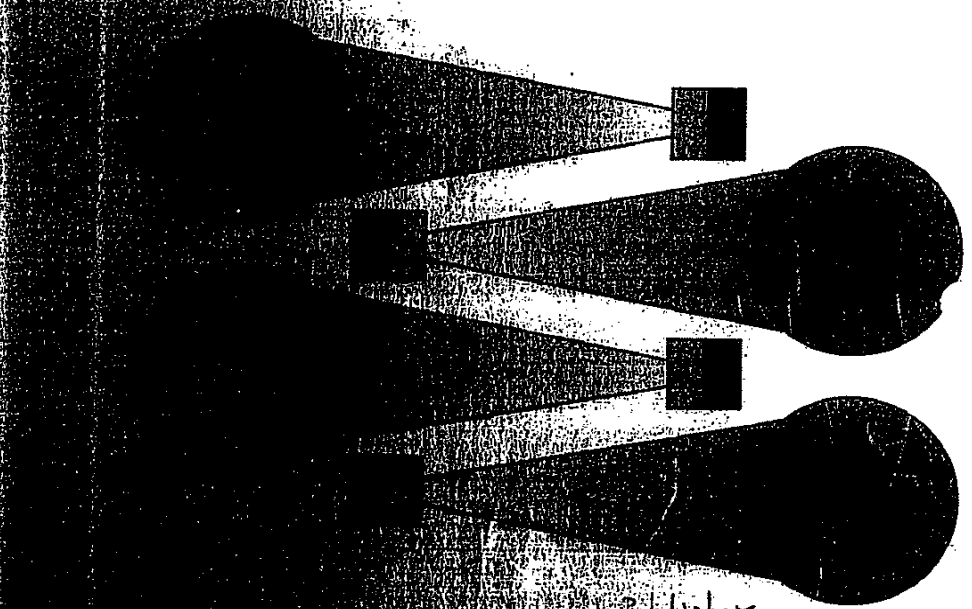
Study on vehicular ABS

自動車用ABSの研究

Anti-lock Braking System

日本エーピーエス株式会社 編

Edited by Japan ABS co.,ltd.



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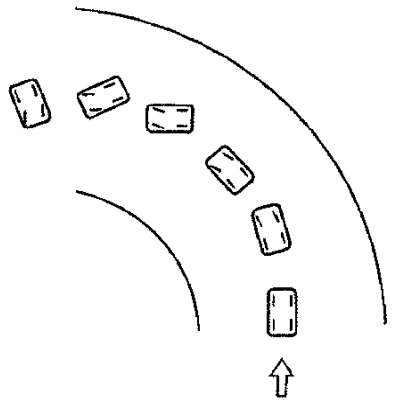

図 2-5　後輪だけがロックした場合　only rear wheels are locked up

図 2-6　全車輪がロックした場合

れ、図 2-6 に示すように車両は上述の 2 つの現象を合わせた運動をする。すなわち、運転者のハンドル操作とはまったく無関係に不規旋転しながらカーブの接線方向に滑って行く。

以上述べたように、適当な強さでブレーキをかければ効果的に車両を停止させることができるが、ブレーキをかけ過ぎて車輪をロックさせると、それは種々の危険性を伴った車両の運動を生じさせる最大の原因となる。し

たがって、凍結路、雪道、砂利道、悪路、水に濡れた道路、乾いた道路、直進路、カーブなどの道路条件や、車両の速度、ハンドル操作など道路条件や走行条件に応じて、常に車輪をロックさせないように注意してブレーキを操作しなければならない。

2.1.2　荷重の移動

車両の重量は各々の車輪によって支えられている。そのためにタイヤと路面との接触面には図 2-7 に示すようなタイヤ荷重と呼ばれる垂直方向の力が作用している。そして、このタイヤ荷重は、ブレーキ時の制動力やコーナリング時の遠心力によって車両の重心に作用する慣性力（質量×加減速度）のために、次のように変化する。

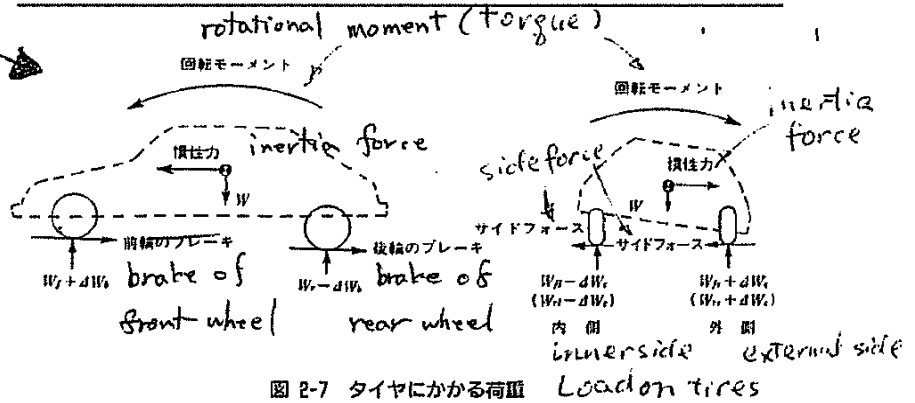

図 2-7　タイヤにかかる荷重

(1)　制動力による変化

ブレーキ時に発生する制動力は、タイヤ荷重と制動摩擦係数の積で表される。そして車両は制動力の総和に比例して減速するが、この力と同じ大きさで方向が逆、つまり進行方向を向いた慣性力が車両の重心に作用する。そのため、車両が前のめりになるような回転モーメントが生じ、前輪ではタイヤ荷重が ΔW_b だけ増加し、後輪では ΔW_b だけ減少する。制動摩擦係

永妻比佐夫（ながつまひさお）
昭和21年生まれ。
昭和63年日本エービーエス㈱に入社。
現在、電子設計部ソフトウェア設計課長としてABS/ASR用ソフトウェアの開発、設計に従事。

木越英雄（きごしひでお）
昭和22年生まれ。
昭和45年日本エヤーブレーキ㈱(現ナブコ)に入社。乗用車用ABSのアクチュエータの開発、設計およびシステム開発に携わる。
現在、自動車技術部第2開発室長として商用車用ABS/ASRの開発、設計に従事。

佐松安夫（さまつやすお）
昭和27年生まれ。
昭和60年日本エービーエス㈱に入社。
現在、技術部第1機器設計課長としてABS/ASR用アクチュエータの開発、設計に従事。

赤壁導史（あかかべよしふみ）
昭和29年生まれ。
昭和60年日本エービーエス㈱に入社。
現在、技術部管理課長として特許業務および技術管理業務に従事。

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Therefore, load on front wheels increases from 700 kg to 780 kg, while load on rear wheels decreases from 700 kg to 620 kg. As a result, according to load dependency of the cornering force, the cornering force of the front wheels increases, while the cornering force of the rear wheels decreases. This gives rise to a yaw moment as shown in Fig. 3-31(2), which causes the vehicle to spin. How should such a situation be handled?

There is only one thing a driver can do: brake and, at the same time, quickly turn the steering wheel back, so as to make the cornering force of the front wheels the same as the rear wheels, thereby avoiding a spin for the moment (Fig. 3-31(3)). However, there are not so many people capable of doing such steering at once. Mostly, a driver simply clings to the steering wheel and trusts to luck. Therefore, it is necessary to make improvement on the vehicle side.

b) Stability improvement using a suspension property

As an improvement using a suspension property, a general measure is a "toe-control" method. Specifically, the yaw moment shown in Fig. 3-31(2) can be reduced by making front wheels toe-out and rear wheels toe-in (Fig. 3-31(4)).

As a recent general trend, the toe-in property of the rear wheels arises in response to a longitudinal force applied to the suspension when braking, i.e., a so-called "longitudinal force compliance steer." On the other hand, the toe-out property of the front wheels is realized by combining the "longitudinal force compliance steer" and a "roll steer" that utilizes a dive (a plunge-forward posture of the vehicle) caused by braking, i.e., a "bound stroke."

However, in order to ensure braking stability, properly maintaining such suspension property alone is insufficient. As another important element, it is necessary to properly maintain braking force distribution between front and rear wheels. This subject will be introduced in section 1 of chapter 6. As a measure of further improving braking stability, there is a case where an LSD (Limited Slip Differential) property is used. This subject will be discussed in section 3 of chapter 6.

3-5 Vehicle posture control

(1) Vehicle posture control

Tilting backward at a sudden acceleration, tilting forward at braking, and making a large roll during a cornering are general images of dynamic posture changes of a vehicle. These posture changes of a vehicle appear to be natural, considering a longitudinal load shift due to inertia force caused by starting or braking, and lateral load shift due to a centrifugal force.

Takaaki UNO

Born in Kyoto in 1955. Completed master's program in engineering in the graduate school of the University of Tokyo. Joined Nissan Motor Co., Ltd. in 1981; in charge of Fairlady Z and Skyline suspension design and HICAS design. From 1992, in charge of vehicle chassis planning and suspension design. Currently, conducting FR vehicle chassis planning and suspension design, as a Chief for the First Chassis Design Section in the First Vehicle Design Department of the First Product Development Division. Main awards include Award of Society of Automotive Engineers of Japan for HICAS development and SAE Arch T. Colwell Merit Award of America for multi-link suspension development.

"Vehicle kinematic performance and chassis mechanism"
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Publisher: Keiji OZAKI
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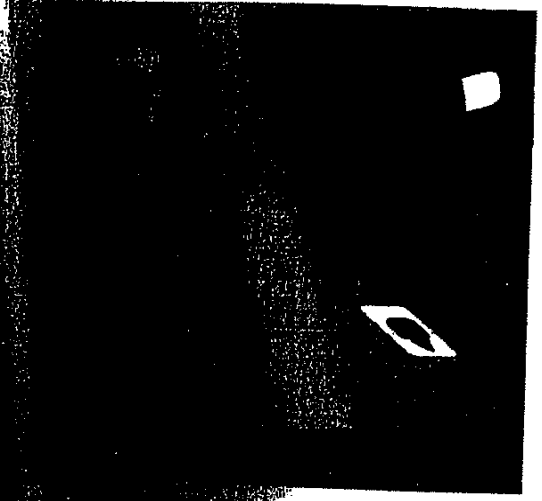
performance of vehicular movement
and
mechanism of chassis

車両運動性能とシャシーメカニズム

Uno Takaaki
宇野 高明



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である。具体的には図3－31(2)の回頭モーメントを減らせばよいから，ブレーキングに伴い，前輪はトーアウト，後輪はトーインとなればよい(図3－31(4))。

後輪のトーイン特性はブレーキングに際し，サスペンションに加わる前後力に応じて発生させるのが最近の一般的な傾向である。いわゆる"前後力コンプライアンスステア"である。一方，前輪のトーアウト特性については，"前後力コンプライアンスステア"と，ブレーキング時に発生するダイブ(車両姿勢の前下がり)，すなわちバウンドストロークを利用した"ロールステア"を組み合わせて実現していく。

しかし，ブレーキング時のスタビリティを確保するにはこのようなサスペンション特性の適正化だけでは不十分で，もうひとつの重要な要素として，前輪と後輪のブレーキ力配分の適正化が必要となる。これについては6章1節で紹介しよう。また，さらにブレーキング時のスタビリティを高める方策として，LSD(リミテッドスリップデフ)特性を活用する場合もある。これについては，6章3節でみることにしよう。

3-5. 車両姿勢コントロール

(1)車両姿勢コントロール

勢いよく発進するときは尻下がり，急ブレーキのときは前のめり。また，コーナリング時には大きなロールというのが一般的にイメージされる車両の動的姿勢変化である。これら車の姿勢の変化は，発進・制動時の慣性力による前後荷重移動や，遠心力による内外輪荷重移動から考えれば至極当然のようではある。

しかし，これらはサスペンションジオメトリーによってある程度コントロールできるものである。他の性能のことを考えずにセッティングすれば，発進時に尻上がり，制動

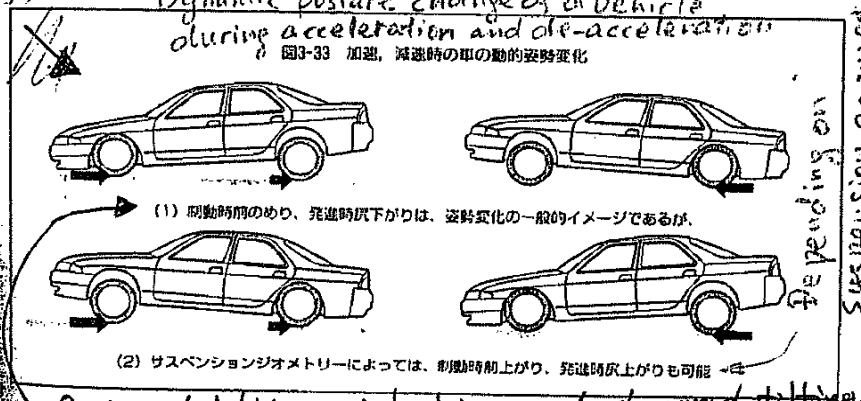

図3-33　加速，減速時の車の動的姿勢変化

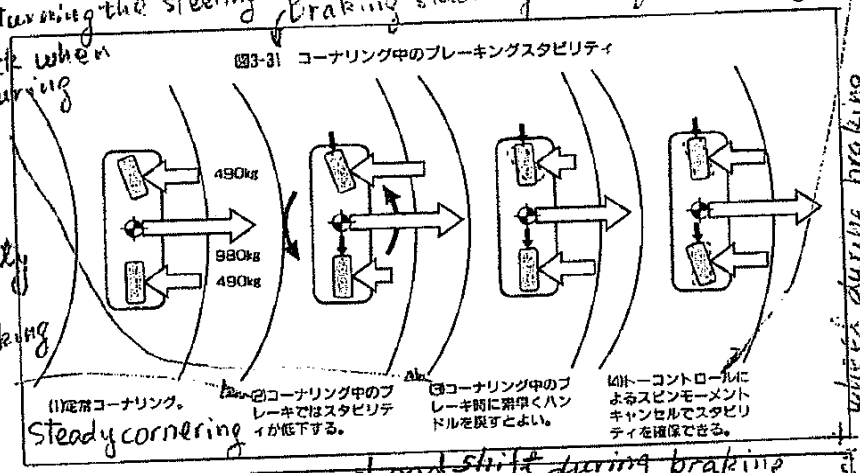

図3-31　コーナリング中のブレーキングスタビリティ

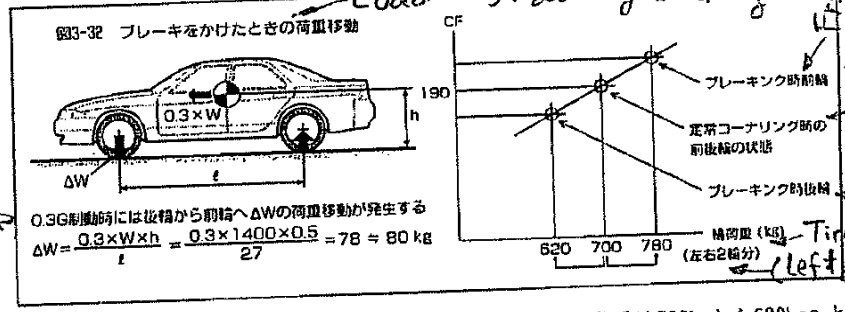

図3-32　ブレーキをかけたときの荷重移動

0.3G制動時には後輪から前輪へΔWの荷重移動が発生する

$$\Delta W = \frac{0.3 \times W \times h}{\ell} = \frac{0.3 \times 1400 \times 0.5}{27} = 78 \fallingdotseq 80\ \mathrm{kg}$$

したがって前輪荷重は700kgから780kgへ増加し，また後輪荷重は700kgから620kgへと減少する。その結果コーナリングフォースの荷重依存特性により，前輪のコーナリングフォースは増大し，後輪のコーナリングフォースは減少する。これは図3－31(2)のような回頭モーメントとなり，車をスピンさせる原因となる。このような状況に陥った場合はどうすればよいか。

ドライバーにできることはひとつ。ブレーキングと同時にハンドルを瞬時に切り戻し，前輪のコーナリングフォースを後輪と同じにすれば，ひとまずはスピンから逃れられる(図3－31(3))。しかし，とっさにこのようなハンドル操作ができる人はそう多くはない。たいていはハンドルにしがみついて運を天に任す状況となる。したがって，車側で改善の策を講じる必要がでてくる。

b)サスペンション特性を利用したスタビリティの向上

サスペンション特性による改善として一般的な方策は"トーコントロール"による方

宇野高明(うの・たかあき)

1955年京都府生まれ。東京大学大学院工学系研究科修士課程修了。1981年日産自動車株式会社に入社し，フェアレディZ，スカイラインのサスペンション設計，HICASの設計を担当。1992年より乗用車のシャシー計画とサスペンション設計を担当。現在，第一商品開発本部第一車両設計部第一シャシー設計課主担としてFR乗用車のシャシー計画，サスペンション設計にたずさわっている。主な受賞歴として，HICASの開発で日本自動車技術会賞，マルチリンクサスペンションの開発でアメリカSAEアークコーウェルメリット賞などがある。

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著者　宇野高明
発行者　尾崎桂治

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